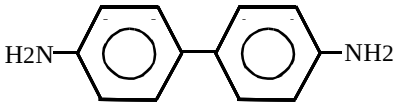
BENZIDINE

Benzidine is a federal hazardous air pollutant and was identified as a toxic air contaminant in April 1993 under AB 2728.

CAS Registry Number: 92-87-5

Molecular Formula: $C_{12}H_{12}N_2$



Benzidine is a white or slightly reddish, crystalline powder which darkens on exposure to air and light. It is soluble in hot water, alcohol, and ether, and slightly soluble in cold water (Merck, 1983).

Physical Properties of Benzidine

Synonyms: [1,1'-biphenyl]-4,4'-diamine; p-diaminodiphenyl; 4,4'-biphenyldiamine; p,p'-dianiline

Molecular Weight:	184.23
Boiling Point:	400 °C
Melting Point:	116 - 129 °C
Vapor Density:	6.36 (air = 1)
Density/Specific Gravity:	1.250 at 20/4 °C (water = 1)
Log Octanol/Water Partition Coefficient:	1.34
Water Solubility:	520 mg/l at 25 °C
Henry's Law Constant:	0.388 x 10^{-10} atm-m^3/mole
Conversion Factor:	1 ppm = 7.53 mg/m^3

(Howard, 1990; HSDB, 1991; Merck, 1983; Sax, 1989; U.S. EPA, 1994a)

SOURCES AND EMISSIONS

A. Sources

Benzidine is used for organic synthesis, in the manufacture of dyes, for detection of blood stains, as a stain in microscopy, as a reagent, and as a stiffening agent in rubber compounding (Sax, 1989). Benzidine is emitted both from facilities that produce it and facilities where it is used as an intermediate in the manufacture of azo dyes.

Benzidine is now only produced in the United States for “captive consumption”. Regulations

require that it be maintained in isolated or closed systems to limit its release (HSDB, 1991). No emissions of benzidine from stationary sources in California were reported, based on data obtained from the Air Toxics "Hot Spots" Program (AB 2588) (ARB 1997b).

B. Emissions

No emissions of benzidine from stationary sources in California have been reported, based on data obtained from the Air Toxics "Hot Spots" Program (AB 2588) (ARB, 1997b).

C. Natural Occurrence

Benzidine has not been reported to occur in nature (Howard, 1990).

AMBIENT CONCENTRATIONS

No Air Resources Board data exist for ambient measurements of benzidine. However, a 1978 United States Environmental Protection Agency (U.S. EPA) reference reported atmospheric concentrations of benzidine to range from 2.5 to 17.6 milligrams per cubic meter or 0.33 to 2.34 parts per million (HSDB, 1991).

INDOOR SOURCES AND CONCENTRATIONS

No information about the indoor sources and concentrations of benzidine was found in the readily-available literature.

ATMOSPHERIC PERSISTENCE

Benzidine in the atmosphere would likely occur in the form of aerosols, subject to gravitational fallout or absorption on water droplets and subsequent washout (Howard, 1990). Benzidine in the gas-phase will react with the hydroxyl radical with an estimated half-life and lifetime of 1.5 hours and 2-3 hours, respectively (Atkinson, 1995).

AB 2588 RISK ASSESSMENT INFORMATION

The Office of Environmental Health Hazard Assessment reviews risk assessments submitted under the Air Toxics "Hot Spots" Program (AB 2588). Of the risk assessments reviewed as of December 1996, benzidine was not listed in any of the risk assessments (OEHHA, 1996a,b).

HEALTH EFFECTS

Probable routes of human exposure to benzidine are inhalation, ingestion, and dermal contact (U.S. EPA, 1994a).

Non-Cancer: Benzidine may cause methemoglobinemia. Results from animal studies indicate chronic effects on the blood, liver, kidney, and central nervous system from oral exposure (U.S. EPA, 1994a).

A chronic non-cancer Reference Exposure Level (REL) of 10 micrograms per cubic meter ($\mu g/m^3$) is listed for benzidine and its salts in the California Air Pollution Control Officers Association Air Toxics "Hot Spots" Program, Revised 1992 Risk Assessment Guidelines. The toxicological targets considered for chronic toxicity are the central or peripheral nervous system, gastrointestinal system, and liver (CAPCOA, 1993). The U.S. EPA has established an oral Reference Dose (RfD) for benzidine of 0.003 milligrams per kilogram per day based on brain cell vacuolization in mice, and liver cell alterations in female mice. The U.S. EPA estimates that consumption of this dose or less, over a lifetime, would not likely result in the occurrence of chronic, non-cancer effects (U.S. EPA, 1994a).

The U.S. EPA has determined that there are inadequate data to establish a Reference Concentration (RfC). No information is available on adverse reproductive or developmental effects of benzidine exposure in humans. Benzidine has been reported to cause teratogenic effects in chicks (U.S. EPA, 1994a).

Cancer: The U.S. EPA has classified benzidine as Group A: Human carcinogen based on sufficient epidemiological evidence. The U.S. EPA has calculated an inhalation unit risk estimate of 6.7×10^{-2} (microgram per cubic meter)$^{-1}$. The U.S. EPA estimates that if an individual were to breathe air containing benzidine at 2×10^{-5} $\mu g/m^3$, over an entire lifetime, that person would theoretically have no more than a 1 in 1 million increased chance of developing cancer (U.S. EPA, 1994a). The International Agency for Research on Cancer has classified benzidine as a Group 1: Human carcinogen (IARC, 1987a).

The State of California has determined under Proposition 65 that benzidine and its salts, and benzidine-based dyes are carcinogens (CCR, 1996). The inhalation potency factor that has been used as a basis for regulatory action in California is 0.14 (microgram per cubic meter)$^{-1}$ (OEHHA, 1994). In other words, the potential excess cancer risk for a person exposed over a lifetime to 1 $\mu g/m^3$ of benzidine is estimated to be no greater than 140,000 in 1 million. The oral potency factor that has been used as a basis for regulatory action in California is 5.0×10^{2} (milligram per kilogram per day)$^{-1}$ (OEHHA, 1994).